CHECK-RAS

HEC-RAS Automated Review Program
User's Manual

CHECKRAS - D:\CRV1\MultiOpen\MO.prj

File Data Checks Report Help

Open Extract NT XS Floodway Structure Profile Report

```
                    CHECK-RAS Program: Structure Check

Project File:    D:\CRV1\MultiOpen\MO.prj
Plan File:       D:\CRV1\MultiOpen\MO.p02
Geometry File:   D:\CRV1\MultiOpen\MO.g01
Flow File:       D:\CRV1\MultiOpen\MO.f02
Report File:     D:\CRV1\MultiOpen\MO.br
Selected profiles: PF 1;PF 2
Date: 7/19/00
Time: 7:14:53 AM


RS        MaxLoChord    MnTpRd    EGEL     WSEL     MinChEl   Structure
----------------------------------------------------------------------
Tulpehocken Crk,TUL
 23371                            364.23   363.85   353.7
 22438                            363.5    363.23   351.8
 21429                            362.7    362.18   349.9
 20341                            361.62   361.02   348.5
 20239                            361.47   360.79   346.4
 20185      368         367       361.44   360.69   346.4     Bridge #1-Up
 20185      366.6       368       361.3    360.52   346.4     Bridge #1-Dn
 20131                            361.26   360.54   346.4
 19960                            360.85   360.61   348
 18972                            360.54   360.47   347.8
 18453                            360.44   360.4    348
 18342                            360.43   360.38   346.8
 18319      356.6       360.22    0        356.6    347.2     Culvert #2-Up
 18319      356.4       358       0        356.4    347       Culvert #2-Dn
 18319      352.1       360.22    0        352.1    347.1     Culvert #3-Up
```

Report   Report File: D:\CRV1\MultiOpen\MO.br   7:15 AM

Federal Emergency Management Agency

July 2000

Version 1.1

CHECK-RAS USER'S MANUAL

TABLE OF CONTENTS

Chapter 1: Introduction

1.1   What Is CHECK-RAS?

The CHECK-RAS program uses a series of checking routines to check the reasonableness of data from HEC-RAS files. HEC-RAS is the U.S. Army Corps of Engineers, Hydrologic Engineering Center, River Analysis System program. CHECK-RAS uses the data from the HEC-RAS geometric, steady flow, and output files to verify that the hydraulic estimates and assumptions made in the model appear to be justified, are in accordance with the applicable Federal Emergency Management Agency (FEMA) requirements, and are compatible with assumptions and limitations of the HEC-RAS program.

CHECK-RAS allows users to examine a variety of parameters from HEC-RAS data files, as well as generate, view, and print reports, which include tables and messages warning about problems with the HEC-RAS input and output. Users can reference additional information about the warning messages by using the **Help Message** database.

CHECK-RAS checking routines cover the following five areas:

- NT (Manning's Roughness Coefficients and Transition Loss Coefficients)

- XS (Cross Sections)

- Structures

- Floodways

- Profiles

Although HEC-RAS also provides some warning messages, CHECK-RAS, version 1.1, differs from HEC-RAS in that it does the following:

- Categorizes floodplain modeling into five distinct areas of checks

- Provides a summary table and warning messages for each checked area

- Assesses the suitability of roughness coefficients and transition loss coefficients

- Assesses the suitability of starting water-surface elevations

- Assesses bridge and culvert modeling

- Provides a detailed floodway analysis

- Compares important parameters among multiple profiles

- Proposes solutions through the use of the **Help** screens

While CHECK-RAS will certainly lead to the production of more accurate HEC-RAS models, the program is not intended to be a replacement for engineering judgment. ***The program flags areas of potential error or concern; however, the user must determine if modifications to the HEC-RAS model are warranted***.

1.2   How to Use the CHECK-RAS User's Manual

The CHECK-RAS User's Manual contains instructions and specifications for running CHECK-RAS, version 1.1, successfully. The manual is not intended to explain how to use HEC-RAS. A basic knowledge of HEC-RAS and familiarity with the HEC-RAS *User's Manual* and *Hydraulic Reference Manual* are necessary to understand the error and warning messages CHECK-RAS provides.

Prior to running CHECK-RAS for the first time, users should:

- Have a good understanding of stream hydraulics,

- Be familiar with the U.S. Army Corps of Engineers (USACE) HEC-RAS program and the HEC-RAS *User's Manual* and *Hydraulic Reference Manual*,

- Have a basic understanding of Microsoft Windows, and

- Read this manual.

This manual references an assortment of HEC-RAS variables and parameters without providing complete descriptions. For a complete description of HEC-RAS variables and parameters, please refer to the HEC-RAS *User's Manual* and *Hydraulic Reference Manual*, version 2.2, September 1998, Davis, California.

This manual takes the user through the program using many illustrations of the various menus, input screens, and results screens. After reading the manual, the user should be ready to start using the program. Throughout the manual, the user is asked to select items from pull-down menus or click on objects. Unless otherwise noted, the user should left-click to select an item.

The text of certain CHECK-RAS operational features has been enhanced to help the user. Enhanced text features include:

- Main Menu Button Bar Icons are placed in a box;

- Command Buttons and Text Fields are underlined; and

- **Windows** are in bold.

1.3   Acknowledgments

This program was developed by Dewberry & Davis LLC under contract to the Federal Emergency Management Agency.

If you have any comments or questions regarding this program, please write to:

<div align="center">

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</div>

Chapter 2: Installing CHECK-RAS

2.1 System Requirements

CHECK-RAS, version 1.1, will run under Microsoft Windows 95/98/NT operating systems.

2.2 Installation Procedures

The user must uninstall any previous versions of CHECK-RAS before installing CHECK-RAS, version 1.1. If no previous version exists on the computer, please follow the procedures under the section "Installing CHECK-RAS."

Uninstalling CHECK-RAS

The following steps should be followed to uninstall a previous version of CHECK-RAS:

1. Click Start button from the Windows 95/98/NT taskbar, point to Settings, and click Control Panel.

2. From Control Panel, double click Add/Remove Programs button.

3. From the list of programs displayed, click CHECK-RAS.

4. Click Remove on Add/Remove Programs button.

5. Click Yes to the question, click OK, and close the window.

All of the program files related to CHECK-RAS will be removed.

Installing CHECK-RAS

From a CD-ROM:

1. On most recent systems, the CD-ROM drive is designated as drive E. The following steps refer to drive E. If necessary, substitute the appropriate drive letter.

2. Insert the CD in the CD-ROM drive.

3. Click the Start button and click Run. The **Run** window will appear. In the Open box, enter the letter for the CD-ROM drive, a backslash, and the word Setup (i.e., "E:\setup"). Click OK.

4. The **CHECK-RAS Setup** window will appear. Follow the instructions on the screen.

5. Accept the default destination location "C:\Program Files\Checkras," or use <u>Change Directory</u> to choose a different location. After CHECK-RAS is installed successfully, close the window.

From the Internet:

1. Download the zipped file from the Internet to a local directory (e.g., "C:\Install") on your computer.

2. Unzip the file and double click on "Setup.exe" to install the program.

3. The **CHECK-RAS Setup** window will appear. Follow the instructions on the screen.

4. Accept the default destination location "C:\Program Files\Checkras," or use <u>Change Directory</u> to choose a different location. After CHECK-RAS is installed successfully, close the window.

Running CHECK-RAS is explained in the following chapter.

Chapter 3: Running CHECK-RAS

3.1   How CHECK-RAS Operates

CHECK-RAS runs within Microsoft Windows. It displays a series of menus and windows. When running CHECK-RAS, version 1.1, the first time, a HEC-RAS Report file must be created through the CHECK-RAS program. While the HEC-RAS Report file is being created, CHECK-RAS inserts a table, CHECKRAS Table, under User Tables in the HEC-RAS Profiles Data window. The CHECKRAS Table includes variables that are not available from Standard Tables or from Detailed Output Data in HEC-RAS.

Once the CHECKRAS Table is inserted into HEC-RAS User Tables, users may generate the HEC-RAS Report file directly from the HEC-RAS program. CHECK-RAS then extracts data from the HEC-RAS Report file. A detailed explanation on creating the HEC-RAS Report file appears in Section 3.3 "Creating a HEC-RAS Report File for Subsequent Runs."

After extracting the data from the HEC-RAS Report file, CHECK-RAS displays the name of the profiles from the last executed plan in the **Select Profile** window. Users can then select a single profile to analyze any single flood recurrence interval, two profiles for a floodway analysis, or two to four profiles for a multiple profile analysis. Users can also select the profiles by clicking the Select Profile option under program menu from the **CHECK-RAS** main window to select different profiles or analyses.

If the single profile is chosen, the NT, XS, and Structure Checks can be run. If two profiles are chosen for a floodway analysis, the NT, XS, Structure, and Floodway Checks can be run. For a floodway analysis, the profiles should include the 1% annual chance discharge. If multiple profiles are chosen, only the Profiles Check can be run. When multiple profiles are chosen, the discharges among the selected profiles must be in increasing order.

After selecting the profiles, users can click one of the "Check" buttons from the **CHECK-RAS** main window to have CHECK-RAS perform the checks. When the Floodway button is selected, CHECK-RAS uses a dialog box to ask whether the default surcharge value of 1.0 foot will be used. To change from the default surcharge, select No, and the **Select Allowable Surcharge** window will be displayed. See Section 3.9 "Select Allowable Surcharge Window" for a detailed explanation of this window.

The user can use either the menu bar or tool bar to run the CHECK-RAS program.

3.2   Running CHECK-RAS for the First Time

The following procedure must be followed when running CHECK-RAS, version 1.1, for the first time.

1. Open the HEC-RAS program and select the project and the plan. Run the plan.
    Click <u>User Tables</u> menu in the **Profile Output Table** window, and check whether there is a table called CHECKRAS. (If <u>User Tables</u> menu is not in the window user must create one user-defined table.) If there is, delete the table.   There must be one user-defined table left under the <u>User Tables</u>. The CHECK-RAS program will insert the correct CHECKRAS table in step 4, below. Close the HEC-RAS program. If there is a file with "rep" as an extension, delete it from the directory where the project and the plan reside by using a program such as Windows Explorer.

2. Click the |Start| button from the Windows taskbar, point to <u>Programs</u>, point to <u>CHECK-RAS</u>, and click the <u>CHECK-RAS</u> icon. The CHECK-RAS opening screen will briefly display, and the **CHECK-RAS** main window, as shown in Figure 1, will appear.
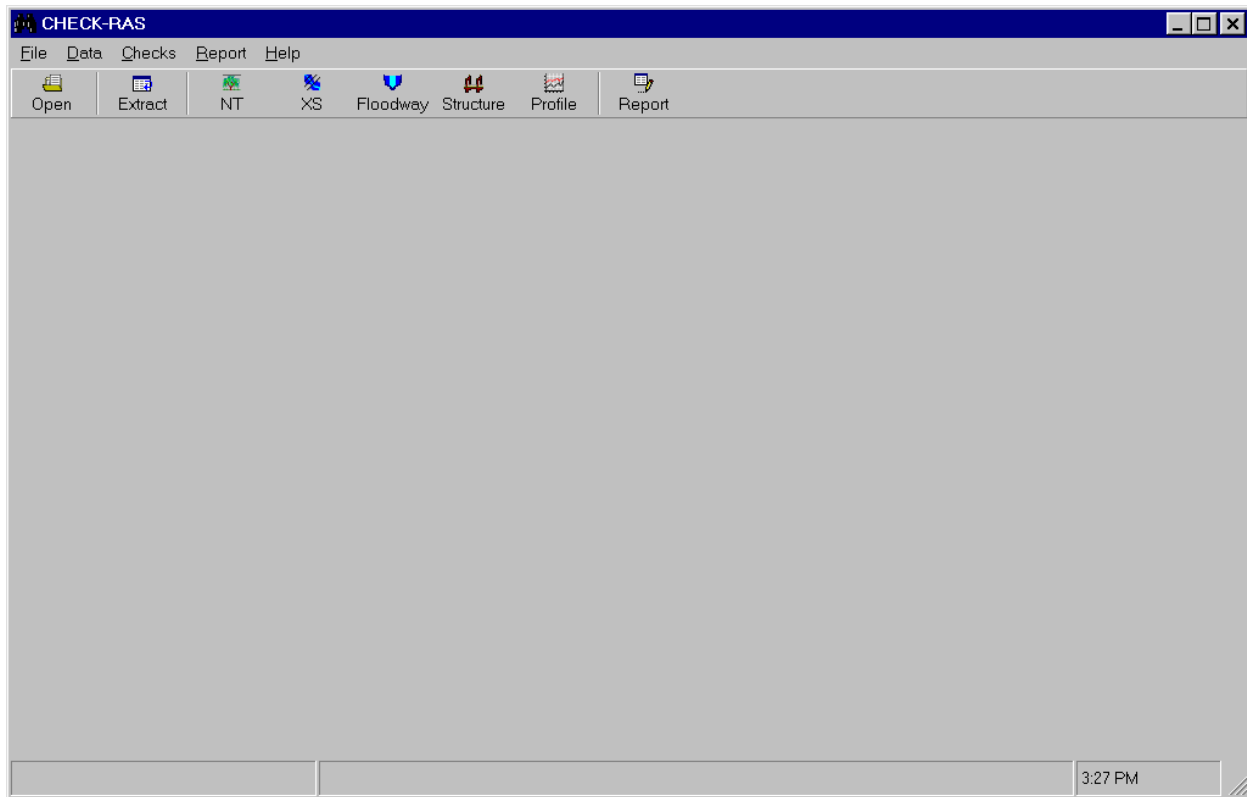
**Figure 1. Main Window in CHECK-RAS**

3. Click the **File** menu, and click the HEC-RAS Setup option. The **HEC-RAS Program Setup** dialog box shown in Figure 2 will appear. If the dialog box is blank, click the Browser button. Locate the "ras.exe" file and click on it. CHECK-RAS will place the path in the **HEC-RAS Program Setup** dialog box. The same procedures can be followed to select a default directory from which you want CHECK-RAS to retrieve the project file. After making the selections, click OK.
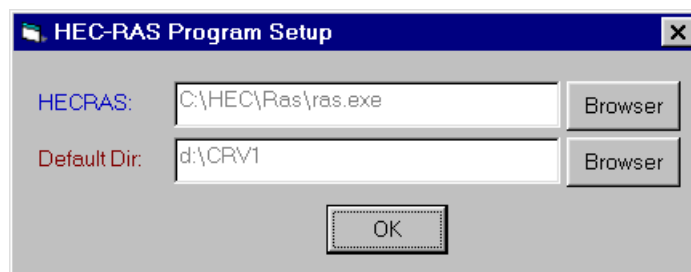
Figure 2. HEC-RAS Program Setup Dialog Box in CHECK-RAS

Click the Open button from the **CHECK-RAS** main window. Locate the directory in which the project file that was used in the first step resides. Double click the project file.

Click the Extract Data button from the **CHECK-RAS** main window. Because the report file has been deleted in the first step, the dialog box shown in Figure 3 will appear.
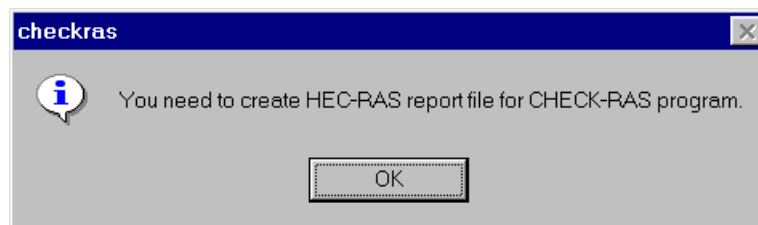

**Figure 3. Create HEC-RAS Report File Message in CHECK-RAS**

4. Click the <u>OK</u> button. The **HEC-RAS** window will appear with the latest plan that was run for the selected project. Click the <u>File</u> menu from the **HEC-RAS** window and click the <u>Generate Report</u> option. The **Report Generator** window, as shown in Figure 4 will appear. At this step, CHECK-RAS will insert the CHECKRAS Table in the User Tables of HEC-RAS and display it in the <u>Selected Summary Tables</u> box in the **Report Generator** window. If it is not there, user should search through the <u>Available Summary Tables</u> box and double click on the CHECKRAS Table.

Please note that all the boxes under <u>Input Data</u> should be checked, and all but one box, <u>Flow Distribution</u>, under <u>Specific Tables (Detailed Output)</u> should be checked. The <u>Summary of Errors, Warnings and Notes</u> box is not checked. Users must ensure that the number of profiles shown under <u>Profiles to Include in Report</u> is correct. Otherwise, click the <u>Set Profiles</u> button and select the profiles to be reviewed. Only CHECKRAS must be displayed in the <u>Selected Summary Tables</u> box. The **Report Generator** window must be configured in this way; otherwise, CHECK-RAS will not be able to extract the data properly.
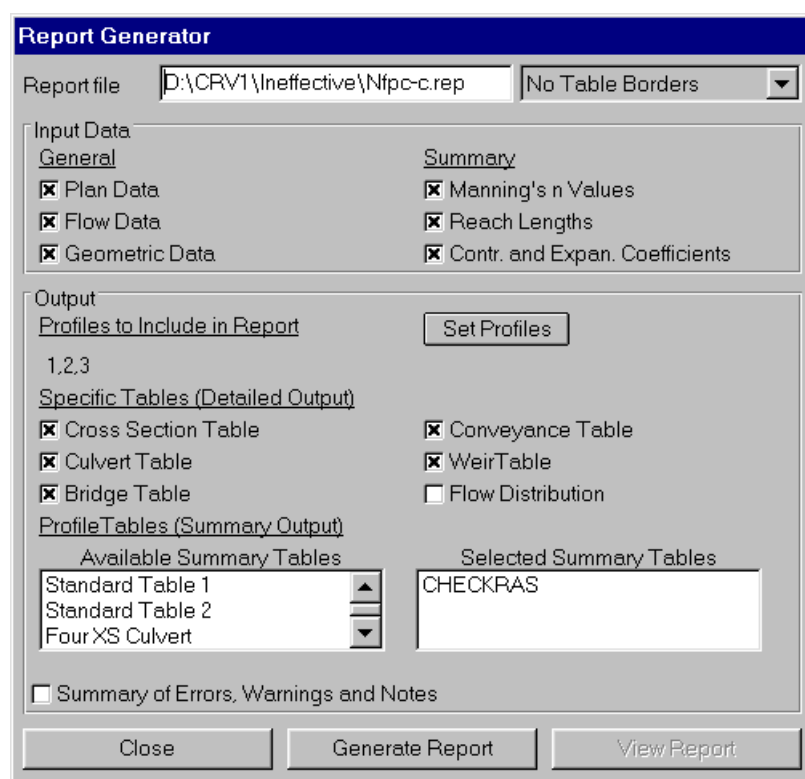
Figure 4. Report Generator Window in HEC-RAS

5. Click the <u>Generate Report</u> button from the **Report Generator** window, and when the <u>View Report</u> button appears, click the <u>Close</u> button. Close the **HEC-RAS** main window.

6. Click the Extract Data button from the **CHECK-RAS** main window. The **Data Extraction** dialogue box will appear and show the progress made in data extraction. Once the data are extracted, the **Select Profile** window, as shown below, will appear.

7. To check the single profile for the NT (Manning's n and Transition Loss Coefficient) Check, XS (Cross-Section) Check, and Structure Check, click the circle in front of the <u>100-year Profile</u>, and click the correct profile from the right-hand most box. To check the floodway run for the NT Check, XS Check, Floodway Check, and Structure Check, two profiles must be selected from the right-hand most box. First, click the circle in front of the <u>100-year Profile</u> and click the correct profile from the right-hand most box. Then click the circle in front of the <u>Floodway Profile</u>, and click the appropriate profile from the right-hand most box. For Multiple Profiles Check, circles in front of <u>10-year Profile</u>, <u>50-year Profile</u>, <u>100-year Profile</u>, and <u>500-year Profile</u> in the <u>Multiple Profiles</u> box are clicked one at a time, and the corresponding profile is clicked from the right-hand most box. For flood insurance studies, it is advisable to name the profiles as 10-year, 50-year, 100-year, 500-year, and floodway so that the profiles can be selected with ease. The profile names can be changed from the <u>Rename Flow Title</u> option under the <u>File</u> menu in the **Steady Flow Data** window of the HEC-RAS program.
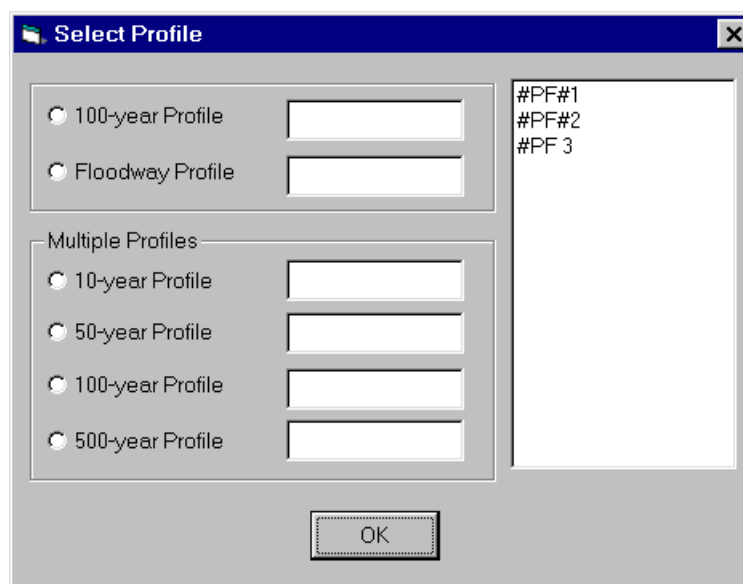
Figure 5. Select Profile Window in CHECK-RAS

8. After selecting the profiles, click the NT , XS , Structure , Floodway , and Profiles buttons from the **CHECK-RAS** main window depending upon the number of profiles selected in the previous step. Click the Report button to view the Summary Tables and messages for each check. The Report button will display only the results from the last check. To view other checks, click the Report menu from the main window and select the check to view.

A brief explanation of each menu is provided in Section 3.4 "CHECK-RAS Main Window." A detailed explanation about the checks is provided in Chapter 4 "Description of CHECK-RAS Programs."

NOTE: *The user should consider following conditions when creating HEC-RAS report file:*

*   *The cross sections must be from upstream to downstream direction in the user table, CHECKRAS*

*   *Select the reaches from* **Profile Table** *window under* **option** *menu if all multiple reaches are to be evaluated.*

*   *It is recommended to use the version 2.2 of HEC-RAS program.*

*   *You must regenerate the HEC-RAS report file when you modify HEC-RAS plan.*

3.3   Creating a HEC-RAS Report File for Subsequent Runs

Through the procedure described above, the CHECKRAS Table is inserted in the User Tables. However, if the CHECKRAS table is not inserted for some reason, users can create the table by including the following variables and checking the appropriate boxes in the **Additional Options** window, as shown in Figure 6 below. This enables users to create a HEC-RAS report file through the **HEC-RAS** main window from which the CHECK-RAS program can extract the data. The CHECKRAS Table includes variables that are not available from the Standard Tables or from the Detailed Output data. The variables in the CHECKRAS Table are:

- Froude # Chl,

- Top Wdth Act,

- Conv. Total,

- Prof Delta WS,

- Left Sta Eff,

- Enc Sta L,

- Center Station,

- Enc Sta R,

- Rght Sta Eff, and

- Min Ch El.

The Left Stagn (Left Stagnation Station) and Rght Stagn (Right Stagnation Station) in the CHECKRAS Table are inserted by HEC-RAS because the Get Multiple Opening XS's box in the **Additional Options** window is checked, as shown in Figure 6 below.

Users should review the CHECKRAS Table to make sure that all the variables are in the table and the appropriate boxes are checked in the **Additional Options** window.
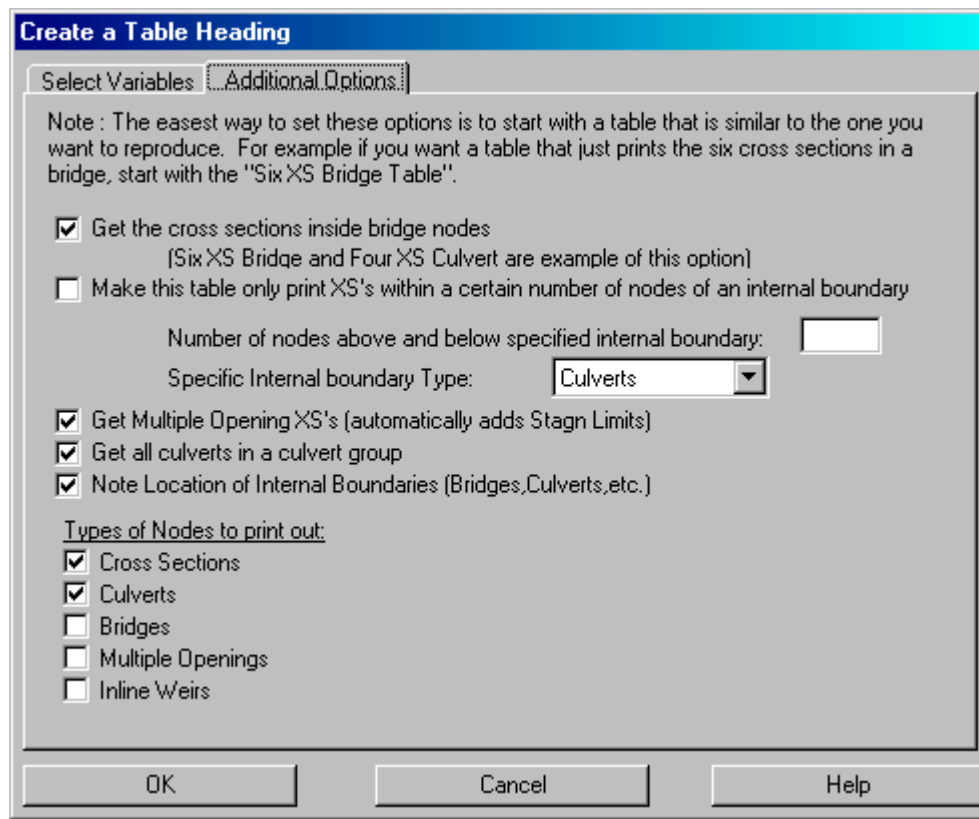
Figure 6. Additional Options Window for CHECKRAS Table in HEC-RAS

After checking a plan with CHECK-RAS program and if you wish to check a different plan, you can open HEC-RAS without closing CHECK-RAS.

Please follow the steps below to create a HEC-RAS Report File for other plans while the CHECK-RAS main window is open:

1. Open the HEC-RAS project file from HEC-RAS. (CHECK-RAS does not include an option to run HEC-RAS.) Run the selected Plan.

2. Click the File menu on the **HEC-RAS** main window and select Generate Report. The boxes that must be checked in the **Report Generator** window are shown in Figure 4

on page 9. The user must check the following boxes from the <u>Input Data</u> area in the **Report Generator** window, if they are not checked.

- <u>Plan Data</u>,

- <u>Flow Data</u>,

- <u>Geometric Data</u>,

- <u>Manning's n Values</u>,

- <u>Reach Lengths</u>, and

- <u>Contraction and Expansion Coefficients</u>.

If the desired profiles are not displayed under <u>Profiles To Include In Report</u>, click the <u>Set Profiles</u> button, and then select the profiles.

The user must check the following boxes from the <u>Specific Tables Detailed Output</u> area if they are not checked.

- <u>Cross Section Table</u>,
- <u>Culvert Table</u>,
- <u>Bridge Table</u>,
- <u>Conveyance Table</u>, and
- <u>Weir Table</u>.

Do not check <u>Flow Distribution</u> box.

Under the <u>Selected Summary Tables</u> box, only CHECKRAS must be displayed. Otherwise, select CHECKRAS from the <u>Available Summary Tables</u> box.

Do not check <u>Summary of Errors, Warnings, and Notes</u> box.

Click the **Generate Report** button. After the report is generated, click the **Close** button. Click the <u>Save Project</u> option under the <u>File</u> menu.

3. Close the **HEC-RAS Program** main window. You now have a HEC-RAS Report file ready to be extracted by the CHECK-RAS program. You must reselect the project again from the CHECK-RAS main window. You can select the project by clicking the <u>File</u> menu or click the Open button.   Follow steps 6, 7, and 8 from the "Running CHECK-RAS" section above to check the HEC-RAS Report file.

3.4   CHECK-RAS Main Window

To access the **CHECK-RAS** main window, click the Start button from the Windows 95/98/NT taskbar, point to Programs, point to CHECK-RAS, and click on the CHECK-RAS icon. The CHECK-RAS opening screen will briefly display, and the **CHECK-RAS** main window (as shown in Figure 1 on page 7) will appear.

The **CHECK-RAS** main window displays the Menu Bar, Tool Bar, and Status Bar.

3.4.1 Main Menu Button Bar Description

The Main Menu Bar includes File, Data, Checks, Report, and Help menus.

File Menu

The File menu includes the following commands:

- Open HEC-RAS Project: displays the **Open File** window at default directory

- Project Information: displays the selected project, plan, geometric, and flow file numbers

- HEC-RAS Setup: locates the path for "ras.exe" file, and the default directory

- Print: prints report file for each check

- Previous Projects: displays up to four previous projects selected by the user

- Exit: closes the CHECK-RAS program

Data Menu

The Data menu includes the following commands:

- Extract Data from HEC-RAS: extracts data from the HEC-RAS Report file

- Select Surcharge: displays the **Select Allowable Surcharge** window

- Select Profiles: displays the **Select Profiles** window

- Run HEC-RAS: displays the **HEC-RAS** program window

Checks Menu

The Checks menu includes the following commands:

NT Check: The NT Check command will invoke CHECK-RAS to perform the following tasks:

- Generate Summary Table

- Generate Summary of Statistics Table

- Check roughness coefficients at cross sections

- Check transition coefficients

- Check roughness coefficients at structures

XS Check: The XS Check command will invoke CHECK-RAS to perform the following tasks:

- Generate Summary Table

- Check distance between cross sections and junctions

- Check ineffective flow options

- Check special conditions

- Check location of cross section

- Check location of discharges

- Check boundary conditions

- Check flow regime

Structure Check: The Structure Check command will invoke CHECK-RAS to perform the following tasks:

- Generate Summary Table

- Check distances between the structure sections

- Check type of flow

- Check culvert coefficients

- Check culvert solution criteria

- Check bridge coefficients

- Check bridge solution criteria

- Check ineffective flow stations and elevations

- Check deck/roadway data and ground data

- Check floodway at the structure

Floodway Check: The Floodway Check command will invoke CHECK-RAS to perform the following tasks:

- Generate Summary Table

- Check encroachment method

- Check starting water-surface elevation of floodway profile

- Check encroachment stations

- Check surcharge values

- Check floodway discharges

Multiple Profiles Check: The Multiple Profiles Check command will invoke CHECK-RAS to perform the following tasks:

- Generate Summary Table

- Check boundary conditions

- Check crossing of water-surface elevations between profiles

- Check discharges

- Check top widths

Reports Menu

The Reports menu allows the user to view the CHECK-RAS reports generated after each checking program is run.

The Reports menu includes the following commands:

- NT
- XS
- Structure
- Floodway
- Multiple Profiles

Help Menu

The Help menu includes the following commands:

- About-
- CHECK-RAS Help

3.4.2 Tool Bar

The Tool Bar includes Open Project, Extract Data, NT, XS, Floodway, Structure, Profiles, and Report buttons. The functions of the buttons are as follows.

- Open Project: displays the **Open File** window
- Extract Data: extracts data from HEC-RAS Report File
- NT: runs Roughness and Transition Loss Coefficients Checking Program
- XS: runs Cross Section Checking Program
- Structure: runs Structure Checking Program
- Floodway: runs Floodway Checking Program
- Profiles: runs Multiple Profiles Checking Program
- Report: displays the Report File of the last check

Clicking on a button will invoke CHECK-RAS to execute the task. The function of each button appears as the mouse passes over the button.

3.4.3 Status Bar

The Status Bar displays the current program and project filename.

3.5   Select Profile Window

The **Select Profile** window displays after CHECK-RAS extracts the data from the HEC-RAS Report File, or when clicking the Data menu and the Select Profile option from the **CHECK-RAS** main window. The **Select Profile** window is shown as Figure 5 on Page 10. There are three different types of profiles that the CHECK-RAS program will analyze. These include:

- Single Profile (100-year Profile),
- Floodway Profile, and
- Multiple Profiles.

CHECK-RAS performs different checks depending upon the selected profile.

CHECK-RAS will analyze

- NT, XS, and Structure Checks for Single Profile,
- NT, XS, Structure, and Floodway Checks for Floodway Profiles, and
- Multiple Profiles Check for Multiple Profiles.

The items in each check are explained in detail in Chapter 4 "Description of CHECK-RAS Programs."

After extracting the data from the latest plan of the HEC-RAS project file, the **Select Profile** window displays the list of profiles under the plan. In order to select the profiles easily, assign the profiles names, such as "10-year profile," "50-year profile," "100-year profile," "500-year profile," and "floodway profile," when running the HEC-RAS plan.

100-year Profile (Single Profile): Select this field for streams without floodways. Select the 1% annual chance (100-year) profile to review flood insurance related studies. For other studies, any single profile can be selected.

First, click on the circle in front of 100-year Profile and click on the corresponding profile from the list of profiles displayed in the box.

Floodway Profile: Floodway analysis should be performed for streams with floodways. First, click the circle in front of 100-year Profile and click the corresponding profile from the list of profiles displayed in the box. Then, click the circle in front of Floodway Profile and the corresponding profile from the list of profiles displayed in the box. The user should recognize the correct profiles.

When the Floodway check button is selected from the main window for floodway analysis, a message box will appear to select a default surcharge value of 1.0. If No button is selected, then the **Select Allowable Surcharge** window will appear with States that have allowable surcharge value less than 1.0 foot. Click on the State to select the allowable surcharge for the current analysis.

Multiple Profiles: Profiles in the Multiple Profiles box should be selected if the results among the profiles are to be compared. CHECK-RAS Multiple Profiles check compares the boundary conditions, water-surface elevations, discharges, and top widths among the profiles.

Users can select up to four profiles. Selected profiles must have discharges in an increasing order. The user must not select the floodway profile for the Multiple Profiles.

First, click the circle in front of 10-year Profile and click the corresponding profile from the list of profiles displayed in the box. The same procedure should then be followed to select other profiles.

If the selected profiles are ready to be used, click the OK button. If any of the profiles is to be changed, click the circle in front of the desired profile and click the profile from the list of profiles displayed in the box.

If the user wishes to change the name of the profiles, first close the **Select Profiles** window, and then close the **CHECK-RAS** main window. Then open the HEC-RAS program, click Steady Flow Data, and select File, Rename Flow Title. After renaming the profiles, rerun the plan.

3.6   Select Allowable Surcharge Window

After the user selects two profiles to be checked from the **Select Profile** window and selects Floodway or Structure check from the main window, the following dialog box will appear.
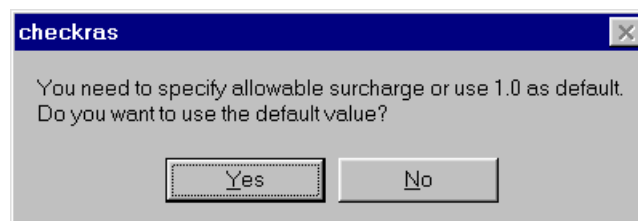
Figure 7. Allowable Surcharge Option Message in CHECK-RAS

If the user selects No, the **Select Allowable Surcharge** window as shown below will be displayed. If the user inadvertently clicks Yes and wants to change the allowable surcharge value, the user can open the **Select Surcharge** window again by clicking the Data menu and Select Surcharge option from the **CHECK-RAS** main window. Click on the State to select the maximum allowable surcharge value and click OK button. This value will be used to check against the computed surcharge values.
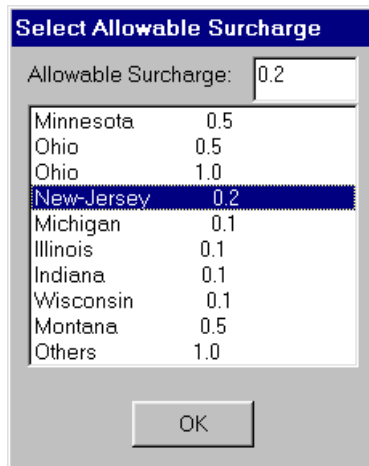
Figure 8. Select Allowable Surcharge Window in CHECK-RAS

3.7   CHECK-RAS Report File Window

The **CHECK-RAS Report File** window will be displayed when the user clicks on the Report menu and selects one of the checks or clicks on the Report button after running a check. Users can print the report file from Print option under File menu. There is no button or option to close the **Report File** window. If you want to view another check, simply click on the desired check button, then click on the Report button. The Summary Table in Report file for NT check is displayed in Figure 9 below.

```
CHECKRAS - D:\CRV1\MultiOpen\MO.prj                                          _ □ ✕
File  Data  Checks  Report  Help

  📥        📑        🌲       ✂       🔱       🏗        📈         📋
 Open     Extract     NT       XS     Floodway  Structure   Profile      Report

                      CHECK-RAS Program: NT Check
              Manning's n Value and Transition Loss Coefficient Review

Project File:    D:\CRV1\MultiOpen\MO.prj
Plan File:       D:\CRV1\MultiOpen\MO.p01
Geometry File:   D:\CRV1\MultiOpen\MO.g01
Flow File:       D:\CRV1\MultiOpen\MO.f01
Report File:     D:\CRV1\MultiOpen\MO.nt
Selected profiles: PF 3
Date: 7/11/00
Time: 3:33:05 PM


SECNO    STRUCTURE         NLOB     NCHL      NROB      CNTR     EXP
----------------------------------------------------------------------------
Tulpehocken Crk,TUL
23371                      0.08     0.035     0.08      0.1      0.3
22438                      0.08     0.035     0.08      0.1      0.3
21429                      0.08     0.035     0.08      0.1      0.3
20341                      0.08     0.035     0.08      0.6      0.8
20239                      0.08     0.035     0.08      0.2      0.4
20185    Bridge-Up         0.08     0.035     0.08      0.2      0.4
20185    Bridge-Dn         0.08     0.035     0.08      0.4      0.6
20131                      0.08     0.035     0.08      0.4      0.6
19960                      0.08     0.035     0.08      0.1      0.3
18972                      0.06     0.035     0.065     0.1      0.3
                           -----    -----     0.04
                           -----    -----     0.065
18453                      0.07     0.035     0.08      0.2      0.4
                           -----    -----     0.04

Report                Report File: D:\CRV1\MultiOpen\MO.nt                  3:33 PM
```

Figure 9. Report File Window in CHECK-RAS

3.7.1 Help Messages Dialog Box

Each reported message has a *Message ID* that consists of the two-letter check identifier followed by two letters representing the type of check and two numbers for the number of message.

By clicking on the line in the report file that contains the Message ID, the Help information will be displayed in the **CHECK-RAS Help Message** dialog box for that particular Message ID. The user can search for multiple Help Messages by clicking lines with the Message ID in the report box. Help information for message NT RC 03 is displayed in Figure 10 below.
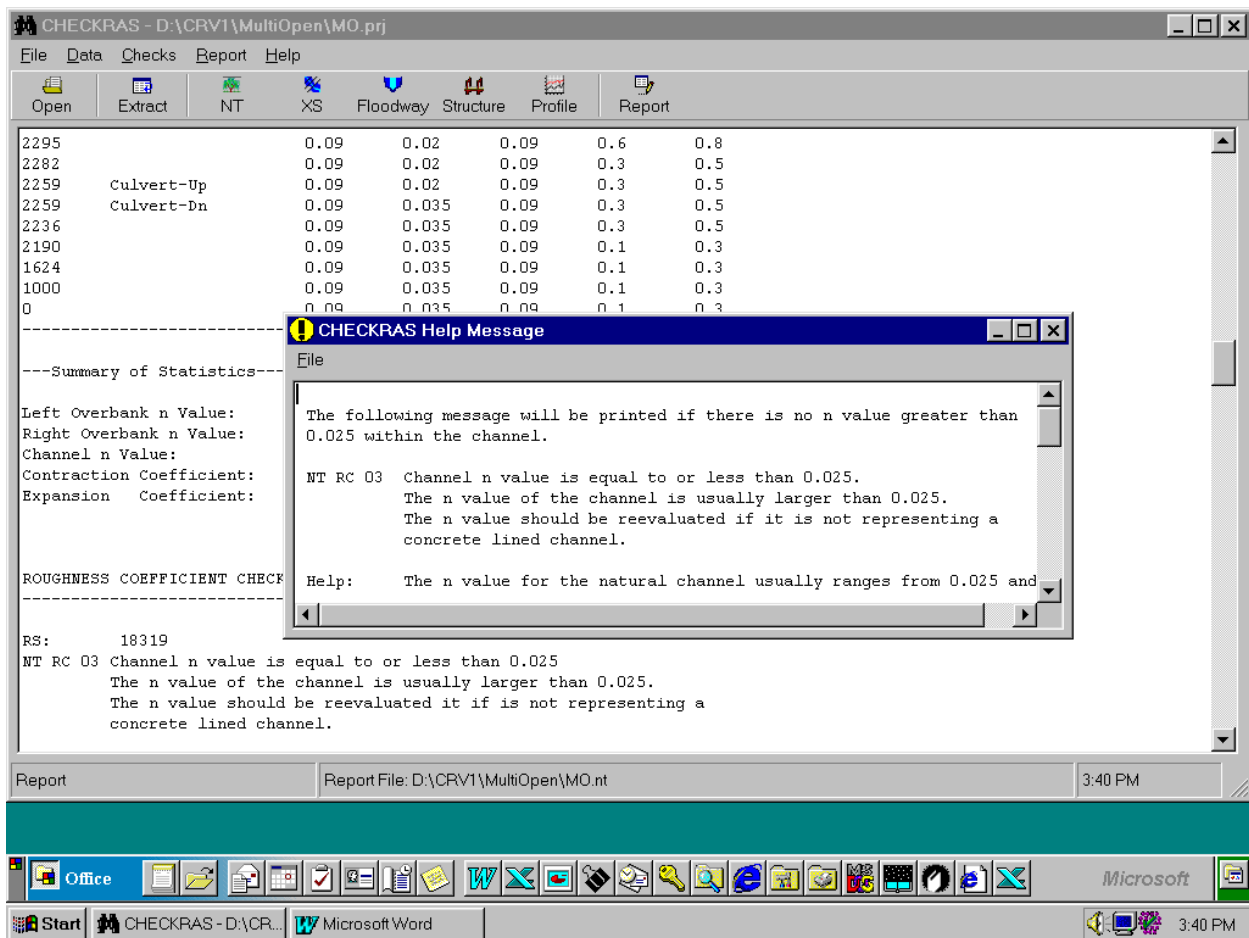
Figure 10. CHECK-RAS Help Message Dialog Box

If the Help information in the **CHECK-RAS Help Message** dialog box is referenced to another Message ID, the user can drag the mouse over the referenced Message ID and release. The referenced Message will be opened to the top of the Message Box.

The help message(s) can be printed from the File menu of the **CHECK-RAS Help Message** dialog box. All the messages and Help information for each message are written in "Checkras.txt" file. If the user has selected the default directory to install the CHECK-RAS program, "Checkras.txt" file is in "C:\Program Files\Checkras" directory. Users are encouraged to print the entire file for easy reference.

In some cases, the problem flagged by CHECK-RAS may be a justifiable modeling approach, even though it may be outside the normal limitations of the HEC-RAS program. In these instances, explain the reasoning for the use of the data and modeling approach in the report file. The user can simply type the reasons in the report file. To

prevent the file from being overwritten by subsequent runs, the user should rename the report file using different primary and extension names. The primary name of the CHECK-RAS report file is the project name, and the extension for NT check is "nt," for XS check "xs," for floodway check "fw," for structure check "br," and for multiple profiles check "mp." The study contractors or requesters should include the renamed CHECK-RAS report file when submitting flood insurance studies and revisions to FEMA.

Chapter 4: Description of CHECK-RAS Programs

Within CHECK-RAS, there are five programs used to verify information for the hydraulic model:

1. NT Check evaluates roughness (Manning's "n") and transition loss coefficients.

2. XS Check evaluates distances, blocked obstructions, critical depth, ineffective flow areas, levees, divided flow, extended cross section, known water-surface elevation, location of cross sections, placement of discharges, boundary conditions, and flow regimes.

3. Structure Check evaluates distances, type of flow, culvert coefficients, culvert solution criteria, bridge coefficients, bridge solution criteria, ineffective flow, deck/roadway and ground data, and floodway at the structure.

4. Floodway Check evaluates the encroachment method, starting water-surface elevation, encroachment stations, surcharge values, and floodway discharge.

5. Multiple Profiles Check compares the starting water-surface elevation methods, crossing of water-surface elevations, discharges, and top-widths for two to four profiles.

Each check is discussed in detail in the following sections.

4.1   NT Check

Summary Table: A Summary Table for all cross sections is created by the NT Check Program consisting of 7 columns, as follows:

- River Station,
- Type of Structure,
- Left Overbank "n" Value,
- Channel "n" Value,
- Right Overbank "n" Value,
- Contraction Loss Coefficient, and
- Expansion Loss Coefficient.

When the horizontal variation in "n" values option is used and the left overbank, right overbank, and channel "n" values are specified by more than one value, each "n" value is shown on one line so that it can be easily seen from the table that multiple "n" values are used at that section.

Summary of Statistics Table: This table is also generated by the NT Check Program and includes the maximum and minimum values for roughness coefficients of the left and right overbanks and the channel from all cross sections in the input file. It also shows the maximum and minimum values of contraction and expansion loss coefficients.

Roughness Coefficients at Cross Sections: The following checks evaluate roughness coefficient values used at cross sections that are not at structures. A detailed explanation of these checks can be found under the <u>Help</u> menu.

- Checks whether left and right overbank "n" values at each cross section are between 0.035 and 0.200.

- Checks whether channel "n" values at each cross section are between 0.025 and 0.100.

Transition Loss Coefficients: The following checks evaluate transition loss coefficient values used at all cross sections in the HEC-RAS input file. A detailed explanation for each of these checks can be found under the <u>Help</u> menu.

- Checks whether the contraction loss coefficient is equal to 0.3 and the expansion loss coefficient is equal to 0.5 at Sections 2, 3, and 4 of the structure.

- Checks that the transition loss coefficients used are 0.1 and 0.3 at cross sections that are not sections 2, 3, and 4 of the structure.

Roughness Coefficient at Structures:

- Checks whether the channel "n" values at Sections 2 and 3 of the structure are less than the channel "n" value of Sections 1 and 4, respectively, by 0.005.

- Checks whether the channel "n" values downstream and upstream of an internal bridge opening section are equal to or larger than the channel "n" value of Sections 2 and 3, respectively.

4.2   XS Check

Summary Table: The summary table generated by the XS Check Program consists of the following 6 columns:

- River Station,

- Left Overbank Distance,

- Right Overbank Distance,

- Channel Distance,

- Total Discharge, and
- Flow Codes.

The flow codes are represented by "B" for blocked obstruction, "C" for critical depth, "D" for divided flow, "E" for extended cross section, and "K" for known water-surface or energy elevation.

Reach Distances:: The following checks are made under Reach Distances Check:

- Length across the junction is not equal to zero
- Whether both the left and right overbank distances at each cross section are greater than the channel distance
- Left overbank, right overbank, and channel distances specified at each cross section are equal to zero
- Whether a ratio of 5:1 is exceeded at any cross section between the right overbank and the channel distance and the left overbank and the channel distance.

Cross-Section Spacing: The program checks the following five variables for each cross section:

- Change in velocity head (HV) value exceeds 0.5,
- Conveyance change (Kratio) is outside the range of 0.7 and 1.4,
- Water depth changes by a factor of 1.1,
- Floodplain topwidth (TopWdthAct) varies by a factor of 2,
- Distance between two cross sections is more than 500 feet.

If all the above conditions are satisfied, additional cross section(s) should be inserted between the cross sections.

Ineffective Flow: The program checks whether the following options are selected or used at a river station:

- Levee
- Normal Ineffective Flow
- Multiple (blocked) Ineffective Flow

Special Conditions: The program prints letters representing special conditions at river stations in the Summary Table.

- Letter "B" represents blocked obstruction.

- Letter "C" represents critical depth.

- Letter "D" represents divided flow.

- Letter "E" represents extended cross section where the computed water-surface elevation exceeds the elevation of the starting and end stations specified of the ground data.

- Letter "K" represents known or changing water-surface or energy elevation.

Location: Checks whether the cross section upstream of a critical depth cross section is located at a distance no greater than the topwidth of the critical depth cross section.

Discharge: The following checks are made under Discharge Check:

- Discharges decrease in the downstream direction

- A constant discharge is used for the entire profile

- The same discharge is used at the downstream and upstream side of a structure

- A value of zero discharge shifts between the left and right overbanks between any two consecutive cross sections

Boundary Condition: The program provides the following information regarding friction slope method and starting conditions at the downstream and upstream boundaries.

- A friction slope method other than the average conveyance method is used and there are channel lengths more than 500 feet within the model.

- Known water-surface

- Energy slope

- Critical Depth

- Elevation-discharge relationship

Flow Regime: The program verifies whether the profiles are computed as:

- Super critical flow regime, or
- Mixed flow regime.

4.3   Structure Check

Summary Table: A Summary Table is created by the Structure Check Program that consists of the following 7 columns:

- River Station,
- Maximum Low Cord Elevation,
- Minimum Road Elevation,
- Energy Gradient Elevation,
- Water-Surface Elevation,
- Minimum Channel Elevation, and
- Type of Structure.

Distance: Checks whether the distance between Section 3 and the upstream face of the structure and the distance between downstream face of the structure and Section 2 are less than the height of the opening.

Type of Flow: The following checks are made under Type of Flow Check:

- The type of flow at structure is either low flow, pressure flow, low and weir flow, or pressure and weir flow
- Criterion used for computing pressure flow is upstream energy grade line
- The pressure/weir method or energy method is used at a bridge when the type of flow is sluicegate pressure flow or sluicegate pressure and weir flow
- The sluicegate Cd value has been specified by the user
- The pressure/weir method or energy method is used at a bridge when the type of flow is submerged pressure flow or submerged pressure and weir flow
- A default submerged Cd value of 0.8 is used when the type of flow is submerged pressure flow.

Culvert Coefficients: The following checks are made under Culvert Coefficients Check:

- Entrance loss coefficient is specified properly
- Exit loss coefficient is equal to 1.0
- Culvert "n" value is specified properly

Culvert Solution Criteria: The following checks are made under Culvert Solution Criteria Check:

- "Highest U.S. EG" is selected as the criterion
- EG at Section 3 is lower than the specified **MinWeirFlowEl** and higher than the **MnTpRd**

Ineffective Flow: The following checks are made under Ineffective Flow Check:

- Multiple (blocked) Ineffective Flow Areas option is used for single opening bridge, or a culvert group, or an inline weir
- Normal Ineffective Flow Area option or Multiple (blocked) Ineffective Flow Areas option is used at Sections 1 and 4 of a structure
- Ineffective flow elevations are higher than **MnTpRd** when weir flow occurs for Multiple (blocked) Ineffective Flow Areas
- Ineffective flow area option is not considered at Sections 2 and 3 when pressure or low flow occurs at a structure
- Ineffective flow elevation is specified properly at Sections 2 and 3 of a structure
- Effective flow area is too narrow when pressure flow occurs at a structure
- Ineffective flow stations are within the abutments of a structure

Geometric Data: The following checks are made under Geometric Data Check:

- Deck/Roadway data is aligned properly with the ground data
- Low cord line crosses the ground line at more than two locations for single opening bridge or within the stagnation limits of a bridge opening for multiple opening analysis
- Sections 2 and 3 are coded as narrowly as the bridge (culvert) opening
- Section 3 centerline station differs from that of Section 2 when weir flow is not computed although EG at Section 3 is higher than **MnTpRd**, or the combination of **Qweir** and **CulvQ** is larger than **Qtotal** by 1%

- The **MnTpRdD** is higher than **MnTpRdU** if the combination of **Qweir** and **CulvQ** is larger than **Qtotal** by 1%

- Centerline station of Section 3 differs from that of Section 2 if encroachment stations are not computed at the Culvert Section and Section 3

- "Cross Section Lid" option is used at Sections 1, 2, 3, and 4 of a structure

Floodway: The following checks are made under Floodway Check:

- Encroachment method is specified at Section 3, Structure Section, and Section 2

- Encroachment Methods 2 and 3 are specified at Section 3, Structure Section, and Section 2

- Encroachment stations are within the abutment stations

- Encroachment stations are within the channel bank stations at Section 3, Bridge section, and Section 2

- Encroachment stations are computed at Section 3 when Encroachment Method 1 is specified at the Structure Section, and Encroachment Method 4 or 5 is specified at Section 3

- Negative surcharge value at Section 3, Bridge-Up Section, Bridge-Dn Section, and Section 2, is less than –0.09

- Surcharge value is more than the allowable surcharge value at Section 3, Bridge-Up Section, Bridge-Dn Section, and Section 2

- Encroachment stations are within the 1% annual chance floodplain

- Encroachment stations over the road for the culvert and the inline weir are within the weir stations of the natural profile

4.4   Floodway Check

Summary Table: The summary table generated by the Floodway Check Program consists of 7 columns. They are:

- River Station,
- Encroachment Method,
- Surcharge Values,
- Natural/Floodway Water-Surface Top Width,
- Floodway Width,
- Channel Width, and
- Type of Structure.

Encroachment Method: The following checks are made under the Encroachment Method Check:

- Encroachment method is specified at the river station

- Encroachment Methods 2 and 3 are used to compute the floodway encroachment stations

- A target surcharge value for water-surface is not specified for Encroachment Methods 4 or 5

- A surcharge target value greater than one foot or the maximum allowable surcharge value for the state where the stream is located is specified at any cross section

Starting Water-Surface Elevation: The following checks are made under the Starting Water-Surface Elevation Check:

- Starting water-surface elevation of the floodway profile is equal to the computed water-surface elevation of the natural profile plus the specified surcharge value

- The difference in conveyance between the floodway profile and the natural profile is more than 1%

Floodway Width: The following checks are made under the Floodway Width Check:

- Encroachment stations are specified within the channel bank stations

- Encroachment stations are outside the 1% annual chance floodplain

- Channel bank stations are selected such that relatively flat overbank exists outside of the channel bank stations

Surcharge Value: The following checks are made under the Surcharge Value Check:

- Negative surcharge values exist in the floodway computations

- Computed surcharge value exceeds the maximum allowable surcharge value at any cross section

- "Change in WS or EG" option is used to specify the floodway water-surface elevation

Floodway Discharge: Checks that the total discharge in the natural and floodway profiles are the same at every cross section.

4.5   Multiple Profiles Check

Summary Table: The summary table generated by the program consists of the following 6 columns:

- River Station,
- Water-Surface Elevation,
- Total Discharge,
- TopWidth Actual,
- Velocity Head, and
- Profile Number.

Boundary Condition: States the starting water-surface method for the downstream and upstream boundary condition for each selected profile.

Discharge: Checks whether the discharges at a river station are in an increasing order.

Crossing of Water-Surface Elevations: Checks whether the water-surface elevation of a lower discharge is higher than that of a higher discharge.

Top Width: Checks whether the top width of a higher discharge is the same as that of a lower discharge, and if so, the velocity head for the higher discharge is more than 0.5 foot.